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FEEDING HABITS OF THE ADULT JAPANESE BEETLE

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INTRODUCTION

The Japanese beetle (*Popillia japonica* Newm.) (fig. 1) was first found in the United States near Riverton, N. J., in the summer of 1916 (*1*).[3] From this point it has spread outward in all directions at a rate of 5 to 10 miles a year until by 1938 the area continuously infested by the insect covered approximately 15,100 square miles and embraced parts of six States—Connecticut, New York, New Jersey, Pennsylvania, Delaware, and Maryland. Within this infested area are two large cities, New York and Philadelphia, about each of which are large suburban residential districts. There are also in this infested area many sections given over to general farming, fruit growing, and the production of truck crops for the markets in the nearby cities. This diversification of conditions and crops has given the insect a wide choice of plants on which to feed, and the Japanese beetle feeds to a greater or lesser degree on over 275 species of plants. This circular lists the known food plants, indicates in a general way their relative attractiveness to the beetle, discusses its feeding habits, and describes in detail its methods of attack on some of the more important economic plants.

[1] Resigned January 16, 1937.

[2] The writers express their appreciation for the assistance rendered by C. H. Hadley, J. L. King, W. E. Fleming, and T. R. Gardner in contributing data concerning the feeding of the beetles on numerous plants.

[3] Italic numbers in parentheses refer to Literature Cited, p. 24.

FIGURE 1.—The Japanese beetle. Approximately × 4.

TYPES OF FEEDING

In feeding on the foliage of most plants, the Japanese beetle eats out small portions of the leaf surface; and, as the veins are avoided, eaten leaves have a lacelike, skeletonized appearance (fig. 2). Leaves thus injured eventually turn brown and most of them fall from the plants. As a result favored food plants in heavily infested areas take on in midsummer a brown appearance, normally characteristic of fall conditions. Trees and shrubs that have lost their leaves as a result of beetle feeding frequently develop a new crop of leaves late in the summer after the beetle attack for that year is past.

The skeletonized foliage of food plants is the most common indication of feeding by the Japanese beetle. On certain plants, however, other types of feeding are sometimes found. On a few plants with thin leaves and fine venation, large irregular-shaped portions are cut off and eaten. Such leaves have the ragged appearance of those fed on by some of the common caterpillars. This type of injury also occurs on the petals of roses and other flowers in which the delicate veins are not unpalatable to the beetle.

Plants with thick, tough leaves are usually free from attack by the Japanese beetle, but in a few cases such leaves are eaten and, as feeding is restricted to the upper surface and does not penetrate through the thick leaf tissue, the freshly-eaten leaves have an uneven, pitted appearance. Later the leaf tissue in the injured areas dies and turns brown.

The Japanese beetle is a gregarious insect, as indicated by the fact that when one or more beetles start to feed on a given plant, other beetles collect and also feed on that plant. As a result of this habit, beetles often gather on the fruit of early ripening varieties of apples and peaches (fig. 3) in large numbers and continue to feed there until only the core or stone remains. In accumulations of this type, spoken of as "balls," as many as 296 beetles have been found on a single apple, although only a few of those in the inner layer may be actually

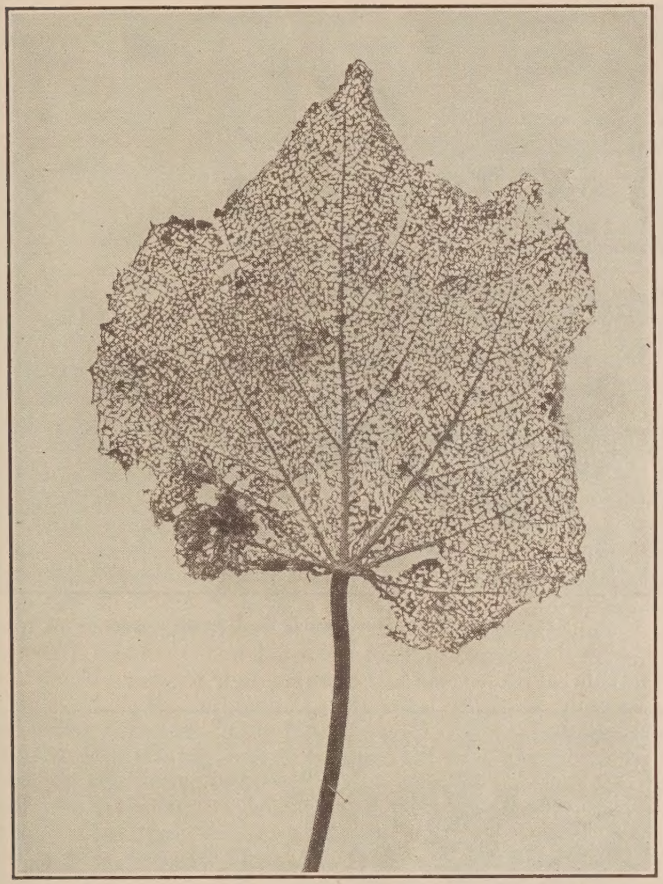

FIGURE 2.—Grape leaf showing injury by the Japanese beetle.

feeding on the fruit (fig. 4). In places where beetles are abundant, balling of this type may occur on every fruit on a tree, and when it is realized that beetles may also be feeding heavily on the foliage, the beetles on a tree often number many thousands. As beetles are always leaving one group or ball for another, the air will be filled with flying insects and a buzzing noise similar to that produced by swarming bees will be heard. In places with light or moderate beetle infestations feeding is more uneven. Here the fruits that were chosen by the first beetles to start feeding will often show balling while other fruits nearby will be entirely free of beetles. Balling, though more common on tree fruits, may also occur on bush fruits, flowers, and, occasionally, on the foliage of food plants.

FACTORS INFLUENCING FEEDING

Japanese beetles are most active and feed most extensively on warm, clear summer days between 9 a.m. and 3 p.m. Earlier in the morning beetles are to be found resting quietly, largely on low-growing

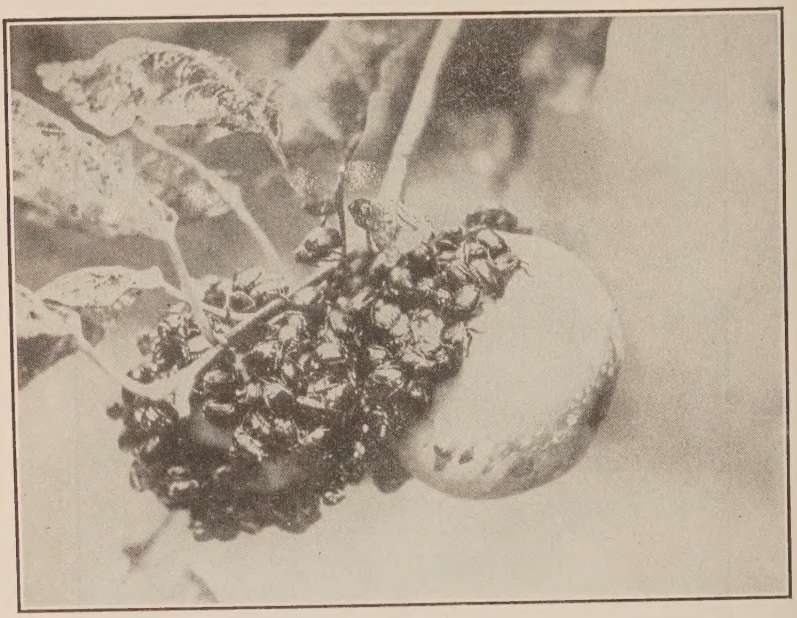

FIGURE 3.—Japanese beetles feeding on apples.

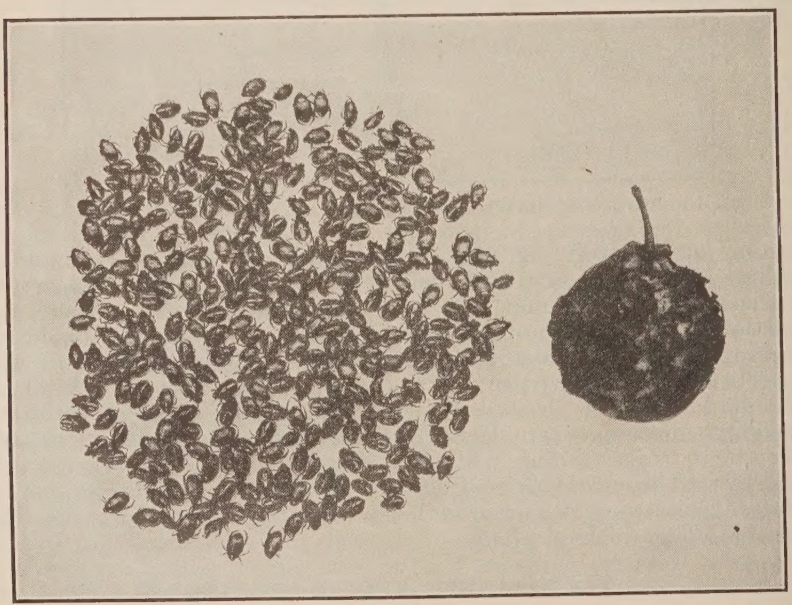

FIGURE 4.—Injury to apple caused by Japanese beetles. Two hundred and ninety-six beetles were found on a single fruit.

plants, and some slight feeding may occur at this time. As the temperature rises, however, they become more active, and when it reaches about 70° F. they start flying about in all directions and collect to feed intensively on the more favored food plants in the locality. Feeding is heaviest at temperatures between 85° and 95°. Temperatures above 95° cause the beetles to become inactive and rest quietly on plants rather than to fly about. When the relative humidity is below 50 to 60 percent the beetles are very active and there is comparatively little feeding. Relative humidity over 60 percent on clear days retards flying activity but induces the insect to feed extensively. Late in the afternoon feeding slackens and beetles again become quiet. At this time many females enter the soil for oviposition, so most of the beetles on the plants from late in the afternoon until activity starts the following morning are males. On cool or windy days there is little flight or feeding.

The Japanese beetle prefers to feed on plants in sunny situations (*10*), and for this reason the foliage on the tops and upper branches on the sunny sides of food plants are most heavily attacked. Plants in the shade are never fed on so heavily as those in the sun, and as a result preferred food plants in close-growing woods are rarely injured by the insect. Beetle activity is greatly reduced on cloudy days, and a sudden change in weather conditions causes an almost instantaneous response by the beetle. The passing of a cloud will cause beetles in flight to seek a suitable resting place immediately, and some have been observed to dig into the soil under such conditions.

In general, however, the degree of feeding on any plant will depend on the attractiveness of that plant to the beetle and on the abundance of the beetles in its immediate vicinity. In cases of dense beetle infestations the feeding tends to be evenly distributed on all favored food plants. In places where beetles are less abundant the insect attacks only the more preferred plants.

In some situations the location of a plant with respect to other plants influences the feeding on that plant. For example, if a plant is situated near favored food plants, many beetles will be drawn to that location and some will come to rest and feed on this plant even though it may not normally be attractive. A case of this kind was observed in a nursery in 1933, where many beetles were attracted to a block of climbing roses on which they fed until the plants were completely defolitated. When this food supply was destroyed, the beetles moved to and fed on evergreens of several kinds that in normal situations are entirely immune from attack.

It is not known definitely why some plants are preferred as food by the Japanese beetle when others closely related botanically are free from attack. It is possible that the succulency of the foliage may be one controlling factor in the selection of food plants, but, though this does have a bearing in many cases, it is not the sole influencing factor. It is known that ripening fruit will attract beetles when immature fruit will not, so it is probable that the beetles are attracted by the odor emanating from maturing fruit. Beetles in flight are sometimes attracted by plant odors that are carried to them by the wind, and beetles even leave the plants on which they are feeding and fly against the wind to other food plants. The texture of leaves is not a deciding factor in the choice of food plants, for among those most preferred may be found plants with all types of

leaf texture and surface. It is known, however, that plants which have a high content of reducing sugar are more attractive to the beetle than plants low in sugar, especially plants whose extracts have a high sugar content and possess a definite fruitlike odor (*6*).

SEASONAL CHANGES IN FOOD-PLANT PREFERENCES

The Japanese beetle shows a seasonal variation in its choice of food plants during the summer feeding period. In the present heavily infested area centering about Philadelphia, feeding usually reaches a conspicuous degree during the last week of June or early in July. At first feeding is confined to low-growing plants such as smartweed, sassafras, and grape, but there may be scattered feeding on other low plants and on sweet cherry trees. At this time there is often much flying about during the warmer part of the day, and beetles have been observed to light on and even ball on plants that were somewhat higher than other plants growing nearby. If these are favored food plants, considerable feeding may occur at this time, but in many cases there is little feeding and the balling seems to be for mating only. In areas of heavy beetle concentration this early-season feeding on low-growing vegetation often continues until the more preferred food plants are stripped of their leaves; and in any case, whether food is wanting or not, some time early in July there is a movement to higher plants and feeding continues on fruit and shade trees for several weeks. Feeding on such preferred hosts as apple, horsechestnut, and linden usually results in the loss of most of the foliage, but in any case as the leaves become older and tougher they are less attractive to the beetles which then return to lower-growing plants. In this last seasonal change the beetles are most abundant on the flowers then in bloom, such as roses and shrub-althea, and on the foliage of plants that are continually putting out new leaves that are more succulent than the older leaves of fruit and shade trees. In farming areas at this time beetles feed on corn silk, asparagus tops, and the leaves and blossoms of clover and alfalfa and on smartweed and other weeds.

In any locality during the beetle season there is then a movement from one type of plant to another that varies the concentration of beetles on the plants. There is a change also from time to time resulting from the movement of female beetles to and from their breeding grounds. As this movement is accompanied also by a movement of the male beetles, a general shifting of the beetle population results. Females prefer grass sod for oviposition, and the locations of such areas may influence the beetle concentration in any locality. Beetles, when in flight, are often carried along with the wind currents for some distance, and this too alters the concentration of beetles in an area. It has often been noted that beetles will be abundant on certain plants for a time and later become scarce on these plants, even though there is plenty of food remaining, and move to other plants, apparently no more attractive, some distance away. Therefore, chance partly governs the feeding that will occur on plants in any area, and any one of a number of factors may have a bearing on beetle abundance at any given point. It sometimes happens that beetles are more abundant in a certain restricted locality one year than they were the preceding or following year, even though in the section as a whole beetles were equally abundant. This, too, may be

attributed to the continual shifting of beetles that goes on through the summer.

TOXIC PLANTS

From time to time plants reputed to have a toxic effect on Japanese beetles that feed on them have been called to the attention of entomologists working with this insect. The usual evidence in these cases is the presence of a large number of dead beetles on the ground beneath the plants on which they had been feeding. In some cases investigated, the supposed killing was not due to the toxic action of the plant, but rather to heavy natural mortality such as occurs late in the beetle season. In certain instances, however, there is good evidence that there are present in some plants certain ingredients that are able to paralyze and even kill the beetle.

The plant most often mentioned as toxic is the geranium. Beetles feed readily on geranium, often become paralyzed, and drop from the plants. Some die but many recover within 24 hours. Affected beetles first give evidence of a paralysis of the legs that later affects the body, causing the beetle to turn on its back and appear dead. Geranium flowers are more effective than the foliage in causing paralysis, and plants in the sunlight are more toxic than those in the shade.

Another plant that has been reputed to kill Japanese beetles that feed on it is the castor-bean plant (*Ricinus communis*). In studies to determine the killing power of this plant it was found that beetles do not feed on all varieties of castor-beans and that the toxic power of those fed on is not at all uniform. Certain varieties of castor-bean do have some killing power, but the degree of killing is not nearly so great as has been alleged by those advocating the use of this plant to destroy the insect (*3*).

Still another plant that has been reported to have a toxic effect on Japanese beetles that feed on it is the great silverbell (*Halesia tetraptera*), an introduced tree occasionally grown in the present infested area. On several occasions it has been reported that beetles feeding on the foliage and seed capsules of this plant have been killed. In studies made with this plant no feeding on the foliage was observed, but there was a slight amount of feeding on the seed capsules, without, however, any conclusive evidence of a toxic effect on the beetles.

The bottlebrush buckeye (*Aesculus parviflora*) has been found to be definitely toxic to Japanese beetles. Laboratory tests and field observations have shown that Japanese beetles feed readily on the flowers of this plant and that if feeding continues long enough the beetles will be killed. The first symptom is paralysis of the legs and body, after which the beetles fall from the plant and die. One hundred dead beetles to the square foot have been found beneath buckeye trees on which beetles had been feeding. This plant is in bloom early in July when beetles are at their peak, the flowering occurring much later than that of the related horsechestnut that produces flowers before beetles appear. The foliage of this buckeye is also eaten by the beetle but the toxic action, if there is any, is much less than that of the flowers.

FEEDING ON ECONOMIC PLANTS

TREE FRUITS

The period during which Japanese beetles are abundant enough to cause injury to plants varies slightly from year to year, but usually extends from July 1 to the middle of August in the area now heavily infested. Plants that mature fruit before or after this period are not seriously injured. Cherries are usually picked before beetles are present in numbers. The fruit of late varieties of apples and peaches is not harmed because the beetles are nearly all gone when it matures. The most severe injury occurs to early-ripening apples and peaches. Such varieties of apples as Yellow Transparent, Starr, Williams (*Williams Early Red*), and Red Astrachan suffer most, and early

FIGURE 5.—Japanese beetles feeding on peach foliage and fruit.

peaches of the varieties Carman, Early Wheeler, Greensboro, and Rochester are most severely attacked (fig. 5). Plum and quince fruits are also eaten. On any of these varieties the characteristic balling may be expected. Imperfect and diseased fruit is especially attractive to the insect. Of the common fruits, only the pear escapes heavy feeding by the beetle.

The foliage of apple, cherry, and plum is very attractive to the beetle, and feeding is often heavy on these trees (fig. 6). The foliage of peach and quince is less attractive, but in cases of heavy infestation the foliage on these trees may also be eaten. The feeding on foliage is often related to the feeding on the fruit, for if the beetles are attracted to the trees by the fruity odor of ripening fruits, the foliage of such trees will be more heavily eaten than that of trees without fruit or with immature fruit.

In certain cases where apple trees have been defoliated by the beetle a second crop of leaves, and occasionally blooms, appear during the latter part of August or early in September. Observations made on such trees have shown that when the defoliation occurs early in the season, fewer fruit buds are produced and there may be a reduction in the crop of the following year. It has also been noted that trees that

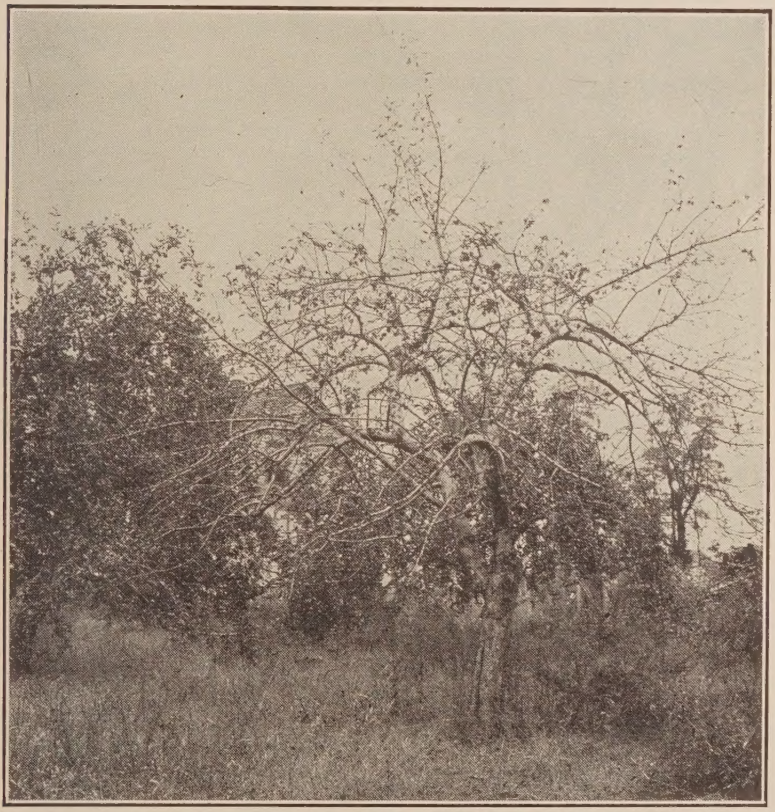

FIGURE 6.—Apple tree almost completely defoliated by the Japanese beetle.

had two sets of leaves the previous year are somewhat later in breaking into foliage than trees that were protected from beetle attack.

BUSH FRUITS

The fruit and foliage of blackberries, blueberries, huckleberries, and raspberries are eaten by the Japanese beetle. In cases of severe infestation the balling so characteristic of the feeding of the insect occurs on the berries. The foliage of currant and grape is eaten. In fact, grape foliage is one of the most preferred foods of the beetle early in the season, but the small immature grapes are never attacked.

The injury to red raspberries is usually not of economic importance on the one-crop varieties such as Latham. In the case of the two-crop berries, however, the beetle causes severe reduction of the second

crop by feeding on the terminal shoots of the plant. These growing tips produce the fruit that is harvested in August, and when they are injured the crop is materially reduced. The Ranere variety is particularly susceptible to beetle injury of this nature.

FIGURE 7.—Japanese beetles feeding on the silks of corn.

A considerable portion of the fruit on cultivated blueberry plants is generally harvested before beetles become abundant in the summer. After July 1, however, ripe berries are vigorously attacked by this insect, and after the fruit has been entirely removed feeding occurs on the new growth, which is much more succulent than the older leaves.

FIELD, TRUCK, AND GARDEN PLANTS

Corn is one of the preferred food plants of the Japanese beetle. The leaves and tassels are sometimes eaten, but the silk of both field and sweet corn is highly attractive to the insect and will be fed on in most situations. Beetles collect on the maturing silks in balls and often cut it off as they feed (fig. 7). This prevents pollination of many of the grains and results in the formation of ears lacking a full quota of kernels. Beetles sometimes, after eating the silks, make their way through the husks and feed on the developing kernels at the tips of the ears, thus producing a damage similar to that of the corn earworm. The damage is so heavy in places with high beetle populations that many growers plant their corn late to delay silking until after beetles are reduced in numbers. In other places the growing of sweet corn for market during the beetle season has been largely abandoned.

FIGURE 8.—Japanese beetles feeding on asparagus plants.

The production of asparagus for the metropolitan markets is a thriving business in parts of the infested area. Japanese beetles feed extensively on asparagus tops and do considerable damage to the small leaflets and to the epidermis of the branches and the stalk (*5*). Several hundred beetles sometimes collect on a single plant and bend it over by their weight (fig. 8). As the quality of the tops produced governs to a large extent the value of the crop the following year, the damage from beetle feeding is often a serious matter in heavily infested areas.

Beetles often feed heavily on the leaves of rhubarb (*5*) (fig. 9) and this also reduces the crop of the following year. At times the foliage of beans of all kinds is severely attacked and that of the soybean is especially favored as food by the beetle. The foliage of alfalfa and clover is fed upon, and if the plants are in bloom when beetles are abundant at the time of the movement from trees to lower plants, the blossoms also may be eaten. Clover blossoms are more attractive to the beetle than are those of alfalfa.

FIGURE 9.—Rhubarb plant severely damaged by the Japanese beetle.

SHADE TREES

In all situations such shade trees as elm, horsechestnut, linden, Lombardy poplar, and willow are heavily fed upon. Other trees (fig. 10) are attacked to a lesser degree. Trees are extensively grown for shade in suburban residential areas and in villages, and in such places the feeding by the beetle lowers the value of trees for shade and reduces their vitality, causes the lawns to be littered by the dropping leaves, and results also in a general annoyance to residents as the beetles fly about on sunny days. There is little doubt that the continued defoliation by the Japanese beetle is detrimental to trees; but cases of killing that can be definitely charged to the beetle are rare, because of the difficulty of being sure that other agencies were not involved. In residential situations there is also the possibility of damage to lawns by the larvae of the beetle, and although that is a phase of the subject that does not fall within the scope of this circular, it may be said that the presence or absence of lawns in which the immature stages may develop has a bearing on beetle abundance at any point.

In rural parts of the infested area there are always some shade trees scattered in the fields and about farmhouses, and the feeding on these is usually heavy. There are also, in many places of this type,

FIGURE 10.—Injury caused by the Japanese beetle to foliage: *A*, of Norway maple; *B*, of oak.

apple and cherry trees that, in addition to supplying fruit to the owner, supply some shade. Trees in an area of this kind are usually not highly valued by the home owner and are not protected by sprays, and as a result they are heavily attacked year after year.

ORNAMENTAL PLANTS

Beetles are strongly attracted to certain ornamental plants. Of these the rose is perhaps the most preferred. Not only are the fully developed flowers unusually attractive but the buds, as soon as they show the color of the petals, are subject to attack. As many roses bloom more or less continuously through the beetle season, the heavy concentration of beetles on the flowers and foliage makes them unfit for sale and ruins their ornamental value (fig. 11). There is some evidence that white or yellow roses are more subject to attack than are those of darker hues. The gregarious habit of the Japanese beetle that is so evident on tree fruits also brings about balling on roses as the beetles collect to feed.

FIGURE 11.—Injury to roses as a result of feeding by the Japanese beetle; bud on right uninjured.

In areas heavily infested by the beetle, roses cultivated in greenhouses are damaged by this insect to such an extent that severe losses have been suffered by the growers (*2*). This injury is not the work of beetles feeding during the summer months, but of the insects that emerge in the greenhouses during January and February because of the high temperature inside. The infestation is caused by the introduction of soil containing larvae or by eggs that were laid in it during July and August. As the flowers of rose plants are a favored food of the beetle and because there is no other food available, many blooms are thus ruined for commercial purposes.

Feeding sometimes occurs on other ornamental plants, but not so extensively as on roses. The blooms of shrub-althea, hollyhock, dahlia, and zinnia are attractive to the insect. On the first two plants mentioned as well as on roses, feeding often takes place within the flowers. The beetles crawl into the flower and feed on the base of the petals. Feeding of this type often occurs in places where beetles

are scarce, and their presence will be overlooked unless the flower is carefully examined.

FEEDING ON NONECONOMIC PLANTS

Numerous weeds and other plants of little value are attractive to the Japanese beetle as food. Bigseed ladysthumb, commonly known as smartweed, is most preferred by the beetles when they first appear late in June and early in July. If beetles are present in an area they are more apt to feed on this weed than on any other plant. For this reason, in scouting to determine the occurrence of beetles in places where its presence is uncertain, patches of this weed are always carefully examined. In agricultural areas this weed is common in poorly cultivated fields and along fence rows. There is a period near the height of the beetle season, when most beetles are feeding on fruit and shade trees, during which this weed is not so highly attractive as it is early in the season and also later when the beetles have again moved to lower growing plants. Other noneconomic plants that are especially attractive to the beetle are evening-primrose and sassafras.

DEGREE OF INJURY CAUSED TO VARIOUS PLANTS

Previous publications concerning the Japanese beetle (*1*, *4*, *6*, *7*, *8*, *9*, *11*) have listed certain plants as being immune or subject to attack, and certain of these listings are not in accordance with the data given in the present circular. Several of these apparent discrepancies are caused by the fact that the beetle, in recent years, has fed upon plants in the heavily infested sections of southern New Jersey which were not attacked when the insect was found in a more restricted territory. Other departures from earlier records are caused by the elimination from the lists of certain plants upon which injury was reported but was never completely substantiated.

FOUR CLASSES OF INJURY

The injury caused by the Japanese beetle to various plants can be classified in four main groups as follows: (1) Severe injury, (2) moderate injury, (3) general light injury, and (4) occasional light injury usually occurring in areas of very heavy beetle infestation.

Plants listed in group 1 are attacked wherever beetles are present and many are usually defoliated where this insect is present in considerable numbers. The injury caused by the beetle to the plants in group 2 is less severe than that of group 1, but in the case of plants of economic importance it is sufficient to warrant the employment of control measures. Plants listed in group 3 may be damaged more extensively under certain conditions than under others, but the normal degree of injury caused by the beetle is not of particular economic importance. Group 4 contains those plants upon which beetles have been observed to feed lightly. This condition is not general, but it is quite likely to occur in areas where the beetle is most abundant.

All plants known to the writers as attacked by the Japanese beetle in the four groups mentioned are listed in tables 1, 2, 3, and 4. The plants are listed alphabetically by families and genera in each of the groups, and the index numbers run consecutively.

TABLE 1.—*Plants that are severely injured by the Japanese beetle*

Index No.	Scientific name	Common name	Part attacked
	Aceraceae:		
1	*Acer palmatum* Thunb.	Japanese maple	Leaf.
2	*Acer platanoides* L.	Norway maple	Do.
	Anacardiaceae:		
3	*Toxicodendron radicans* (L.) Kuntze	Poison-ivy	Do.
	Ericaceae:		
4	*Clethra alnifolia* L.	Summersweet	Leaf, flower.
5	*Vaccinium* spp. (several cultivated varieties).	Blueberry	Leaf, fruit.
	Fabaceae:		
6	*Soja max* (L.) Piper	Soybean	Leaf.
	Fagaceae:		
7	*Betula populifolia* Marsh.	Gray birch	Do.
8	*Castanea dentata* Borkh.	American chestnut	Do.
	Hippocastanaceae:		
9	*Aesculus hippocastanum* L.	Horsechestnut	Do.
	Juglandaceae:		
10	*Juglans nigra* L.	Black walnut	Do.
	Lauraceae:		
11	*Sassafras variifolium* (Salisb.) Kuntze	Common sassafras	Do.
	Liliaceae:		
12	*Asparagus officinalis* L.	Garden asparagus	Do.
	Lythraceae:		
13	*Lagerstroemia indica* L.	Common crapemyrtle	Leaf, flower.
	Malvaceae:		
14	*Althea officinalis* L.	Marshmallow	Flower.
15	*Althea rosea* (L.) Cav.	Hollyhock	Leaf, flower
16	*Hibiscus moscheutos* L.	Common rosemallow	Flower.
17	*Hibiscus syriaca* L.	Shrub-althea	Do.
18	*Malva rotundifolia* L.	Common mallow	Do.
	Onagraceae:		
19	*Oenothera biennis* L.	Evening-primrose	Leaf, flower.
	Platanaceae:		
20	*Platanus acerifolia* (Ait.) Willd.	London planetree	Leaf.
	Poaceae:		
21	*Zea mays* L.	Indian corn (field and sweet corn).	Leaf, flower, Fruit.
	Polygonaceae:		
22	*Polygonum orientale* L.	Princesplume	Leaf, flower.
23	*Polygonum pensylvanicum* L.	Bigseed ladysthumb	Leaf.
24	*Rheum rhaponticum* L.	Common rhubarb	Do.
	Rosaceae:		
25	*Amygdalus persica* L.	Peach	Leaf, fruit.
26	*Kerria japonica* (L.) DC.	Kerria	Leaf.
27	*Malus floribunda* Lindl.	Japanese flowering crab	Do.
28	*Malus sylvestris* Mill.	Apple	Leaf, fruit.
29	*Prunus cerasus* L.	Sour cherry	Leaf.
30	*Prunus domestica* L.	Common plum	Leaf, fruit.
31	*Prunus salicina* Lindl.	Japanese plum	Leaf.
32	*Prunus serotina* Ehrh.	Black cherry	Do.
33	*Rosa* spp. (several varieties)	Rose	Leaf, flower.
34	*Sorbus americana* Marsh.	American mountainash	Leaf.
	Salicaceae:		
35	*Populus nigra italica* DuRoi	Lombardy poplar	Do.
36	*Salix discolor* Muhl.	Pussy willow	Do.
	Tiliaceae:		
37	*Tilia americana* L.	American linden	Do.
	Urticaceae:		
38	*Ulmus americana* L.	American elm	Do.
39	*Ulmus campestris* L.	English elm	Do.
	Vitaceae:		
40	*Parthenocissus quinquefolia* (L.) Planch.	Virginia creeper	Do.
41	*Vitis aestivalis* Michx.	Summer grape	Do.
42	*Vitis labrusca* L.	Fox grape	Do.
43	*Vitis vinifera* L.	European grape	Do.

TABLE 2.—*Plants that are moderately injured by the Japanese beetle*

Index number	Scientific name	Common name	Part attacked
	Araceae:		
44	*Peltandra virginica* (L.) Kunth	Virginia arrow-arum	Leaf.
	Araliaceae:		
45	*Aralia hispida* Vent	Bristly aralia	Do.
	Asteraceae:		
46	*Ambrosia elatior* L	Ragweed	Do.
47	*Ambrosia trifida* L	Big ragweed	Do.
48	*Dahlia* spp. (several horticultural varieties, especially those with light colored blooms).	Dahlia	Flower.
49	*Tagetes patula* L	French marigold	Leaf.
50	*Zinnia elegans* Jacq	Common zinnia	Leaf, flower.
	Betulaceae:		
51	*Alnus vulgaris* Hill	Black alder	Leaf.
	Bignoniaceae:		
52	*Catalpa bignonioides* Walt	Southern catalpa	Do.
	Brassicaceae:		
53	*Brassica* sp	Broccoli	Do.
	Cannaceae:		
54	*Canna indica* L. (several horticultural varieties).	Canna	Leaf, flower.
	Caprifoliaceae:		
55	*Viburnum dentatum* L	Arrowwood	Leaf.
	Ericaceae:		
56	*Azalea hinodegiri* Hort	Hinodegiri azalea	Do.
	Fabaceae:		
57	*Kraunhia sinensis* (Sims) Makino	Chinese wisteria	Do.
58	*Medicago sativa* L	Alfalfa	Leaf, flower.
59	*Phaseolus vulgaris* L	Common bean	Leaf.
60	*Trifolium hybridum* L	Alsike clover	Leaf, flower.
61	*Trifolium pratense* L	Red clover	Do.
	Fagaceae:		
62	*Betula alba* L	European white birch	Leaf.
63	*Quercus ilicifolia* Wang	Scrub oak	Do.
64	*Quercus palustris* Muench	Pin oak	Do.
	Hippocastanaceae:		
65	*Aesculus parviflora* Walt	Bottlebrush buckeye	Leaf, flower.
	Hypericaceae:		
66	*Hypericum perforatum* L	St. Johnswort	Do.
	Lauraceae:		
67	*Benzoin aestivale* (L.) Nees	Spicebush	Do.
	Loganiaceae:		
68	*Buddleia davidii* Franch	Orange-eye butterflybush	Do.
	Malvaceae:		
69	*Abutilon theophrasti* Medic	Velvetleaf	Leaf.
70	*Hibiscus trionum* L	Flower-of-an-hour	Leaf, flower.
	Melastomaceae:		
71	*Rhexia virginica* L	Common meadowbeauty	Do.
	Nyctaginaceae:		
72	*Mirabilis jalapa* L	Common four-o'clock	Do.
	Nymphaeaceae:		
73	*Nelumbo lutea* (Willd.) Pers	American lotus	Do.
74	*Nymphaea advena* Ait	Spatterdock	Leaf.
	Osmundaceae:		
75	*Osmunda cinnamomea* L	Cinnamon fern	Do.
	Pinaceae:		
76	*Larix decidua* Mill	European larch	Do.
77	*Taxodium distichum* (L.) L. Rich	Common baldcypress	Do.
	Platanaceae:		
78	*Platanus occidentalis* L	American planetree	Do.
	Polygonaceae:		
79	*Polygonum arifolium* L	Broadleaf tearthumb	Do.
80	*Polygonum convolvulus* L	Cornbind	Do.
81	*Polygonum dumetorum* L	Black buckbind	Do.
82	*Polygonum hydropiper* L	Smartweed	Do.
83	*Polygonum persicaria* L	Ladysthumb	Do.
84	*Polygonum scandens* L	Rough buckbind	Do.
85	*Polygonum sieboldii* De Vries	Japanese fleeceflower	Do.
	Polypodiaceae:		
86	*Pteridium latiusculum* (Desv.) Hieron	Bracken	Do.
	Pontederiaceae:		
87	*Pontederia cordata* L	Pickerelweed	Do.
	Rosaceae:		
88	*Chaenomeles lagenaria* (Loisel.) Koidzumi	Flowering quince	Do.
89	*Cydonia oblonga* Mill	Common quince	Do.
90	*Prunus serrulata* Lindl	Oriental cherry	Do.
91	*Rubus argutus* Link	Highbush blackberry	Do.
92	*Rubus* spp	Raspberry	Leaf, fruit. Flower.

TABLE 2. *Plants that are moderately injured by the Japanese beetle*—Continued

Index number	Scientific name	Common name	Part attacked
	Rubiaceae:		
93	*Cephalanthus occidentalis* L.	Common buttonbush	Leaf, flower.
	Rutaceae:		
94	*Citrus sinensis* (L.) Osbeck	Orange (ornamental)	Do.
	Salicaceae:		
95	*Salix babylonica* L.	Babylon weeping willow	Leaf.
96	*Salix cordata* Muhl.	Heartleaf willow	Do.
	Saxifragaceae:		
97	*Ribes sativum* (Reichb.) Syme	Garden currant	Do.
	Styracaceae:		
98	*Halesia tetraptera* Ellis	Great silverbell	Leaf, fruit.
	Tiliaceae:		
99	*Tilia cordata* Mill.	Littleleaf European linden	Leaf.
100	*Tilia petiolaris* DC.	Weeping linden	Do.
	Typhaceae:		
101	*Typha latifolia* L.	Common cattail	Do.

TABLE 3.—*Plants that are generally lightly injured by the Japanese beetle*

Index No.	Scientific name	Common name
	Aceraceae:	
102	*Acer pseudoplatanus* L.	Sycamore maple.
103	*Acer saccharum* Marsh.	Sugar maple.
	Alismaceae:	
104	*Sagittaria latifolia* Willd.	Common arrowhead.
	Anacardiaceae:	
105	*Rhus copallina* L.	Shining sumac.
	Apocynaceae:	
106	*Apocynum androsaemifolium* L.	Spreading dogbane.
	Asteraceae:	
107	*Calendula officinalis* L.	Calendula.
108	*Cichorium intybus* L.	Chicory.
109	*Erigeron annuus* (L.) Pers.	Whitetop fleabane.
110	*Erigeron canadensis* L.	Horseweed.
111	*Erigeron strigosus* Muhl.	Fleabane.
112	*Eupatorium album* L.	White thoroughwort.
113	*Helianthus annuus* L.	Common sunflower.
114	*Solidago juncea* Ait.	Early goldenrod.
115	*Tagetes erecta* L.	Aztec marigold.
116	*Vernonia noveboracensis* (L.) Willd.	Common ironweed.
	Balsaminaceae:	
117	*Impatiens biflora* Walt.	Spotted snapweed.
	Berberidaceae:	
118	*Berberis thunbergii* DC.	Redleaf Japanese barberry.
	Bignoniaceae:	
119	*Bignonia radicans* L.	Trumpetcreeper.
	Brassicaceae:	
120	*Brassica alba* (L.) Boiss.	White mustard.
	Caprifoliaceae:	
121	*Diervilla florida* Sieb. and Zucc.	Pink weigela.
	Caryophyllaceae:	
122	*Agrostemma githago* L.	Corncockle.
	Chenopodiaceae:	
123	*Beta vulgaris* L.	Beet.
	Convolvulaceae:	
124	*Ipomoea purpurea* (L.) Roth.	Common morningglory.
	Cornaceae:	
125	*Nyssa sylvatica* Marsh.	Tupelo.
	Ericaceae:	
126	*Vaccinium angustifolium* Ait.	Lowbush blueberry.
	Euphorbiaceae:	
127	*Acalypha virginica* L.	Three-seed.
128	*Ricinus communis* L.	Common castorbean.
	Fabaceae:	
129	*Cassia chamaecrista* L.	Partridge-pea.
130	*Lespedeza formosa* (Vogel) Koehne.	Purple bushclover.
131	*Phaseolus lunatus macrocarpus* Benth.	Lima bean.
132	*Pisum sativum arvense* (L.) Poir.	Field pea.
133	*Trifolium repens* L.	White clover.
	Fagaceae:	
134	*Castanea crenata* Sieb. and Zucc.	Japanese chestnut.
135	*Fagus grandifolia* Ehrh.	American beech.
136	*Fagus sylvatica* L.	European beech.
137	*Quercus montana* Willd.	Chestnut oak.
	Geraniaceae:	
138	*Pelargonium domesticum* Bailey.	Lady Washington geranium.
	Iridaceae:	
139	*Gladiolus* spp. (several horticultural varieties, usually those having white or light pink blooms.	Gladiolus.
	Juglandaceae:	
140	*Hicoria alba* (L.) Britton.	Mockernut.
141	*Juglans sieboldiana* Maxim.	Japanese walnut.
142	*Myrica carolinensis* Mill.	Northern bayberry.
	Lobeliaceae:	
143	*Lobelia cardinalis* L.	Cardinal flower.
	Malvaceae:	
144	*Gossypium* sp.	Cotton.
	Menthaceae:	
145	*Salvia splendens* Ker-Gaul.	Scarlet sage.

TABLE 3.—*Plants that are generally lightly injured by the Japanese beetle*—Cont.

Index No.	Scientific name	Common name
	Oleaceae:	
146	*Ligustrum ovalifolium* Hassk.	California privet.
	Oxalidaceae:	
147	*Oxalis stricta* L.	Common yellow oxalis.
	Poaceae:	
148	*Digitaria sanguinalis* (L.) Scop.	Crabgrass.
	Polygonaceae:	
149	*Rumex crispus* L.	Curly dock.
150	*Rumex obtusifolius* L.	Bitter dock.
	Polypodiaceae:	
151	*Onoclea sensibilis* L.	Sensitive fern.
	Ranunculaceae:	
152	*Paeonia* sp.	Peony.
	Rosaceae:	
153	*Crataegus* sp.	Hawthorn.
154	*Exochorda racemosa* (Lindl.) Schneid.	Common pearl-bush.
155	*Fragaria chilonsis* Duchesne.	Chiloe strawberry.
156	*Fragaria* sp.	Strawberry.
157	*Prunus virginiana* L.	Common chokecherry.
	Rosaceae—Continued.	
158	*Rubus cuneifolius* Pursh.	Sand blackberry.
159	*Spiraea tomentosa* L.	Hardhack.
161	*Spiraea triolbata* L.	Threelobe spirea.
161	*Spiraea vanhouttei* Zabel.	Vanhoutte spirea.
	Rubiaceae:	
162	*Galium claytoni* Michx.	Bedstraw.
163	*Galium pilosum* Ait.	Do.
	Saxifragaceae:	
164	*Deutzia grandiflora* Bunge.	Early deutzia.
	Scrophulariaceae:	
165	*Linaria vulgaris* Hill.	Common toadflax.
	Tiliaceae:	
166	*Tilia Tomentosa* Moench.	Silver linden.
	Urticaceae:	
167	*Ulmus fulva* Michx.	Slippery elm.
	Vitaceae:	
168	*Parthenocissus tricuspidata* (Sieb. and Zucc.) Planch.	Japanese creeper.

TABLE 4.—*Plants that are occasionally lightly injured by the beetle, the injury usually occurring only when the plants are growing in areas of very heavy beetle infestation.*

Index No.	Scientific name	Common name
	Aceraceae:	
169	*Acer negundo* L.	Boxelder.
	Amaranthaceae:	
170	*Amaranthus retroflexus* L.	Redroot amaranth.
	Anacardiaceae:	
171	*Cotinus coggygria* Scop.	Common smoketree.
172	*Rhus typhina* L.	Staghorn sumac.
	Apiaceae:	
173	*Daucus carota* L.	Common carrot.
174	*Pastinaca sativa* L.	Parsnip.
	Aquifoliaceae:	
175	*Ilex verticillata* (L.) A. Gray.	Common winterberry.
	Araliaceae:	
176	*Hedera helix* L.	English ivy.
	Asclepiadaceae:	
177	*Asclepias pulchra* Ehrh.	Hairy milkweed.
178	*Asclepias purpurascens* L.	Purple milkweed.
179	*Asclepias syriaca* L.	Common milkweed.
	Asteraceae:	
180	*Achillea millefolium* L.	Common yarrow.
181	*Aster patens* Ait.	Sky-drop aster.
182	*Aster undulatus* L.	Wave aster.
183	*Aster vimineus* Lam.	Small white aster.
184	*Baccharis halimifolia* L.	Groundselbush.
185	*Chrysanthemum leucanthemum* L.	Oxeye daisy.
186	*Chrysanthemum* spp. cultivated.	Chrysanthemum.
187	*Cichorium endivia* L.	Endive.
188	*Cirsium arvense* (L.) Scop.	Canada thistle.
189	*Cosmos bipinnatus* Cav.	Common cosmos.
90	*Cynara scolymus* L.	Artichoke.
	Asteraceae—Continued.	
191	*Eupatorium purpureum maculatum* (L.) Darl.	Joe-pye-weed.
192	*Gaillardia aristata* Pursh.	Common perennial gaillardia.
193	*Galinsoga parviflora* Cav.	Quickweed.
194	*Helichrysum bracteatum* Andr.	Strawflower.
195	*Tragopogon porrifolius* L.	Vegetable-oyster.
	Brassicaceae:	
196	*Brassica oleracea capitata* L.	Cabbage.
197	*Brassica oleracea gemmifera* DC.	Brussels sprouts.
198	*Brassica rapa* L.	Turnip.
	Caprifoliaceae:	
199	*Lonicera japonica* Thunb.	Japanese honeysuckle.
200	*Sambucus canadensis* L.	American elder.
201	*Viburnum opulus* L.	European cranberrybush.
	Chenopodiaceae:	
202	*Chenopodium album* L.	Lambsquarters.
203	*Chenopodium ambrosioides anthelminticum* (L.) A. Gray.	Wormseed.
	Commelinaceae:	
204	*Commelina virginica* L.	Dayflower.
205	*Tradescantia virginiana* L.	Virginia spider wort.
	Convolvulaceae:	
206	*Ipomoea batatas* (L.) Lam.	Sweetpotato.
	Cucurbitaceae:	
207	*Citrullus vulgaris* Schrad.	Watermelon.

TABLE 4.—*Plants that are occasionally lightly injured by the beetle, the injury usually occurring only when the plants are growing in areas of very heavy beetle infestation*—Continued.

Index No.	Scientific name	Common name
	Cucurbitaceae—Con.	
208	*Cucumis melo* L.	Cantaloupe.
209	*Cucumis sativus* L.	Cucumber.
210	*Cucurbita pepo* L.	Pumpkin.
211	*Cucurbita pepo condensa* Bailey.	Crookneck summer squash.
212	*Sicyos angulatus* L.	Star cucumber.
	Cyperaceae:	
213	*Cyperus esculentus* L.	Chufa.
	Ebenaceae:	
214	*Diospyros virginiana* L.	Common persimmon.
	Ericaceae:	
215	*Azalea kaempferi* (Planch.) André.	Torch azalea.
216	*Azalea mollis* Blume.	Chinese azalea.
217	*Azalea viscosa* L.	Swamp azalea.
218	*Gaylussacia baccata* (Wang.) C. Koch.	Black huckleberry.
219	*Rhododendron catawbiense* Michx.	Catawba rhododendron.
220	*Rhododendron* spp.	Rhododendron.
221	*Vaccinium macrocarpon* Ait.	Cranberry.
	Fabaceae:	
222	*Meibomia canescens* (L.) Kuntze.	Hoary tickelover.
223	*Pisum sativum* L.	Common pea.
224	*Robinia pseudoacacia* L.	Common locust.
225	*Vicia sativa* L.	Common vetch.
	Fagaceae:	
226	*Corylus americana* Walt.	American hazelnut.
227	*Quercus alba* L.	White oak.
228	*Quercus borealis maxima* (Marsh.) Ashe.	Common red oak.
229	*Quercus coccinea* Muench.	Scarlet oak.
230	*Quercus rubra* L.	Southern red oak.
231	*Quercus stellata* Wang.	Post oak.
232	*Quercus velutina* Lam.	Black oak.
	Ginkgoaceae:	
233	*Ginkgo biloba* L.	Maidenhair-tree.
	Hamamelidaceae:	
234	*Hamamelis virginiana* L.	Common witch-hazel.
235	*Liquidambar styraciflua* L.	Sweetgum.
	Iridaceae:	
236	*Iris germanica* L.	German iris.
237	*Iris japonica* Thunb.	Fringed iris.
238	*Iris kaempferi* Sieb.	Japanese iris.
	Juglandaceae:	
239	*Hicoria glabra* (Mill.) Britton.	Pignut.
240	*Hicoria ovata* (Mill.) Britton.	Shagbark hickory
241	*Juglans cinerea* L.	Butternut.
	Liliaceae:	
242	*Hemerocallis fulva* L.	Tawny daylily.
243	*Smilax rotundifolia* L.	Common greenbrier.
	Lythraceae:	
244	*Lythrum salicaria* L.	Purple loosestrife.
	Malvaceae:	
245	*Abelmoschus esculentus* (L.) Moench.	Okra.
	Menthaceae:	
246	*Leonurus cardiaca* L.	Common motherwort.
247	*Monarda didyma* L.	Oswego beebalm.
248	*Monarda fistulosa* L.	Wildbergamot.
249	*Nepeta cataria* L.	Catnip.
250	*Teucrium canadense* L.	American germander.
	Moraceae:	
251	*Ficus elastica* Roxb.	India rubbertree.
	Musaceae:	
252	*Musa sapientum* L.	Common banana (ornamental).
	Oleaceae:	
253	*Ligustrum vulgare* L.	European privet.
	Pinaceae:	
254	*Cryptomeria japonica* (L. f.) D. Don.	Common cryptomeria.
255	*Juniperus chinensis pyramidalis* Beiss.	Column Chinese juniper.
256	*Juniperus communis* L.	Common juniper.
257	*Pinus virginiana* Mill.	Scrub pine.
258	*Thuja occidentalis* L.	American arborvitae.
	Plantaginaceae:	
259	*Plantago lanceolata* L.	Buckhorn plantain.
260	*Plantago major* L.	Common plantain.
	Poaceae:	
261	*Cortaderia selloana* (Schult.) Asch. and Graebn.	Common pampas-grass.
262	*Phleum pratense* L.	Timothy.
	Polemoniaceae:	
263	*Phlox paniculata* L.	Garden phlox.
	Polygonaceae:	
264	*Fagopyrum vulgare* Hill.	Common buckwheat.
	Polypodiaceae:	
265	*Adiantum capillus-veneris* L.	Southern maidenhair.
	Ranunculaceae:	
266	*Clematis paniculata* Thunb.	Sweet autumn clematis.
	Rosaceae:	
267	*Pyrus communis* L.	Common pear.
	Rubiaceae:	
268	*Gardenia* sp.	Gardenia.
	Saxifragaceae:	
269	*Hydrangea petiolaris* Sieb. and Zucc.	Climbing hydrangea.
	Simaroubaceae:	
270	*Ailanthus altissima* (Mill.) Swingle	Ailanthus.
	Solanaceae:	
271	*Lycium halimifolium* Mill.	Common matrimony-vine.
272	*Petunia hybrida* Vilm.	Common petunia.
273	*Solanum melongena* L.	Eggplant.
274	*Solanum tuberosum* L.	Potato.
	Urticaceae:	
275	*Humulus lupulus* L.	Common hop.
	Verbenaceae:	
276	*Verbena hastata* L.	Blue vervain.
277	*Verbena urticifolia* L.	White vervain.

THE FAMILIES AND GENERA MORE FAVORED BY THE BEETLE

The preference of the beetle for certain groups of plants is clearly demonstrated in a summary of the data given for groups 1, 2, and 3, namely, the plants on which feeding normally occurs. This summary is presented in table 5, which includes 60 families, 118 genera, and 169 species.

TABLE 5.—*Botanical classification of all plants generally attacked by the Japanese beetle*

Family	Genera	Species	Family	Genera	Species	Family	Genera	Species
	Number	*Number*		*Number*	*Number*		*Number*	*Number*
Aceraceae	1	4	Fabaceae	9	11	Oxalidaceae	1	1
Alismaceae	1	1	Fagaceae	4	9	Pinaceae	2	2
Anacardiaceae	2	2	Geraniaceae	2	2	Plantaginaceae	1	1
Apocynaceae	1	1	Hippocastanaceae	1	2	Platanaceae	1	1
Araceae	1	1	Hypericaceae	1	1	Poaceae	2	2
Araliaceae	1	1	Iridaceae	1	1	Polygonaceae	4	12
Asteraceae	11	15	Juglandaceae	3	4	Polypodiaceae	2	2
Balsaminaceae	1	1	Lauraceae	2	2	Pontederiaceae	1	1
Berberidaceae	1	1	Liliaceae	1	1	Ranunculaceae	1	1
Betulaceae	1	1	Lobeliaceae	1	1	Rosaceae	13	24
Bignoniaceae	2	2	Loganiaceae	1	1	Rubiaceae	2	3
Brassicaceae	1	2	Lythraceae	1	1	Rutaceae	1	1
Cannaceae	1	1	Malvaceae	5	8	Salicaceae	2	4
Caprifoliaceae	2	2	Melastomaceae	1	1	Saxifragaceae	2	2
Caryophyllaceae	1	1	Menthaceae	1	1	Scrophulariaceae	1	1
Chenopodiaceae	1	1	Nyctaginaceae	1	1	Styracaceae	1	1
Convolvulaceae	1	1	Nymphaeaceae	2	2	Tiliaceae	1	4
Cornaceae	1	1	Oleaceae	1	1	Typhaceae	1	1
Ericaceae	3	4	Onagraceae	1	1	Urticaceae	1	3
Euphorbiaceae	2	2	Osmundaceae	1	1	Vitaceae	2	5

As indicated in table 5, the members of certain plant families have a strong attraction for the beetle, this situation being particularly in evidence in the case of the Asteraceae, Rosaceae, Malvaceae, Polygonaceae, Fabaceae, and Fagaceae. On the other hand, no solanaceous plants are to be found in these groups and only one member of the Menthaceae.

These data appear to be significant, and may prove to be of value in determining what species should be included in new plantings in sections where the beetle is abundant. It also appears evident that certain plants which grow in areas not now infested by the beetle are likely to be attacked when the beetle reaches these sections, whereas other plants will most certainly be immune to attack.

SOME OF THE COMMON PLANTS UPON WHICH THE BEETLE HAS NOT BEEN OBSERVED TO FEED

In table 6 is given a list of 89 common plants on which the Japanese beetle has not been observed to feed.

TABLE 6.—*A partial list of the more common plants upon which the Japanese beetle has not been observed to feed.*

Index No.	Scientific name	Common name
	Aceraceae:	
278	*Acer rubrum* L.	Red maple.
279	*Acer saccharinum* L.	Silver maple.
280	Amaranthaceae:	
	Celosia cristata L.	Common cockscomb.
	Aquifoliaceae:	
281	*Ilex opaca* Ait.	American holly.
	Asteraceae:	
282	*Ageratum* sp.	Ageratum.
283	*Coreopsis grandiflora* Hogg.	Big coreopsis.
284	*Lactuca sativa* L.	Lettuce.
285	*Leontodon taraxacum* L.	Dandelion.
286	*Rudbeckia laciniata* L.	Cutleaf coneflower.
	Balsaminaceae:	
287	*Impatiens balsamina* L.	Garden balsam.
	Brassicaceae:	
288	*Brassica campestris* L.	Rutabaga.
289	*Brassica oleracea botrytis* L.	Cauliflower.
290	*Brassica oleracea viridis* L.	Kale.
291	*Iberis semperrirens* L.	Evergreen candytuft.
292	*Raphanus sativus* L.	Radish.
	Buxaceae:	
293	*Buxus sempervirens* L.	Common box.
	Calycanthaceae:	
294	*Calycanthus floridus* L.	Common sweetshrub.
	Caprifoliaceae:	
295	*Lonicera fragrantissima* Lindl.	Winter honeysuckle.
296	*Symphoricarpos orbiculatus* Moench.	Coralberry.
	Caryophyllaceae:	
297	*Dianthus barbatus* L.	Sweet-william.
298	*Dianthus caryophyllus* L.	Clove pink.
299	*Gypsophila repens* L.	Creeping gypsophila.
	Celastraceae:	
300	*Celastrus scandens* L.	American bittersweet.
301	*Euonymus* spp.	Euonymus.
	Chenopodiaceae:	
302	*Spinacia oleracea* L.	Common spinach.
	Cornaceae:	
303	*Cornus florida* L.	Flowering dogwood.
	Crassulaceae:	
304	*Sedum spectabile* Boreau.	Showy sedum.
	Dipsacaceae:	
305	*Scabiosa atropurpurea* L.	Sweet scabiosa.
	Ericaceae:	
306	*Azalea nudiflora* L.	Pinxterbloom.
307	*Kalmia latifolia* L.	Mountain-laurel.
	Fabaceae:	
308	*Baptisia australis* R. Br.	Blue wild-indigo.
309	*Cercis chinensis* Bunge.	Chinese redbud.
310	*Lathyrus odoratus* L.	Sweet pea.
	Fumariaceae:	
311	*Bikukulla formosa* (Ands.) Howell.	Western bleeding-heart.
	Liliaceae:	
312	*Allium cepa* L.	Onion.
313	*Allium porrum* L.	Leek.
	Magnoliaceae:	
314	*Liriodendron tulipfera* L.	Tuliptree.
315	*Magnolia grandiflora* L.	Southern magnolia.
316	*Magnolia virginiana* L.	Sweetbay.
	Menthaceae:	
317	*Dracocephalum virginianum* L.	Virginia false dragonhead.
318	*Hedeoma pulegioides* (L.) Pers.	American pennyroyal.
319	*Hyssopus officinalis* L.	Hyssop.
320	*Mentha spicata* L.	Spearmint.
	Moraceae:	
321	*Ficus carica* L.	Common fig.
	Oleaceae:	
322	*Forsythia intermedia* Zabel.	Border forsythia.
323	*Forsythia suspensa* Vahl.	Weeping forsythia.
324	*Fraxinus americana* L.	White ash.
325	*Fraxinus lanceolata* (Borkh.) Sarg.	Green ash.
326	*Syringa persica* L.	Persian lilac.
327	*Syringa vulgaris* L.	Common lilac.
	Papaveraceae:	
328	*Papaver nudicaule* L.	Iceland poppy.
	Phytolaccaceae:	
329	*Phytolacca americana* L.	Common pokeberry.
	Pinaceae:	
330	*Abies concolor* (Gord.) A. Murray	White fir.
331	*Chamaecyparis thyoides* (L.) B. S. P.	White cedar.
332	*Picea abies* (L.) Karst.	Norway spruce.
333	*Picea orientalis* (L.) Carr.	Oriental spruce.
334	*Pinus sylvestris* L.	Scotch pine.
335	*Tsuga canadensis* (L.) Carr.	Canada hemlock.
	Poaceae:	
336	*Avena sativa* L.	Oat.
337	*Bambusa* sp.	Bamboo.
338	*Hordeum vulgare* L.	Barley.
339	*Secale cereale* L.	Rye.
340	*Setaria italica* (L.) Beauv.	Millet.
341	*Triticum aestivum* L.	Wheat.
	Portulacaceae:	
342	*Portulaca grandiflora* Hook.	Common portulaca.
	Ranunculaceae:	
343	*Aquilegia* sp.	Columbine.
344	*Delphinium formosum* Boiss. and Huet	Hardy larkspur.
345	*Ranunculus sceleratus* L.	Blister crowfoot.
	Resedaceae:	
346	*Reseda odorata* L.	Common mignonette.
	Salicaceae:	
347	*Populus alba* L.	White poplar.
348	*Populus alba pyramidalis* Bunge.	Bolleana poplar.
	Saxifragaceae:	
349	*Grossularia oxyacanthoides* (L.) Cov. and Britton	Canada gooseberry.
350	*Grossularia reclinata* (L.) Mill.	European gooseberry.

TABLE 6.—*A partial list of the more common plants upon which the Japanese beetle has not been observed to feed*—Continued.

Index No.	Scientific name	Common name
	Saxifragaceae—Con.	
351	*Hydrangea arborescens* L.	Smooth hydrangea.
352	*Hydrangea paniculata* Sieb.	Panicle hydrangea.
353	*Philadelphus coronarius* L.	Sweet mockorange.
	Scrophulariaceae:	
354	*Antirrhinum* spp.	Snapdragon.
355	*Chelone glabra* L.	White turtlehead.
356	*Digitalis purpurea* L.	Foxglove.
357	*Verbascum thapsus* L.	Flannel mullein.
	Solanaceae:	
358	*Capsicum annuum* L.	Common redpepper.
359	*Lycopersicon esculentum* Mill.	Tomato.
360	*Nicotiana tabacum* L.	Common tobacco.
	Staphyleaceae:	
361	*Staphylea trifolia* L.	American bladdernut.
	Tropaeolaceae:	
362	*Tropaeolum majus* L.	Common nasturtium.
	Urticaceae:	
363	*Morus rubra* L.	Red mulberry.
	Verbenaceae:	
364	*Callicarpa dichotoma* Raeusch.	Chinese beautyberry.
	Violaceae:	
365	*Viola papilionacea* Pursh.	Butterfly violet.
366	*Viola tricolor* L.	Common pansy.

SUMMARY OF PLANTS LISTED

Table 7 gives a summary of the numbers of families, genera, and species listed in the tables. Naturally there are duplications in the cases of the families and genera, but each species appears only once in the tables.

TABLE 7.—*Summary of plants listed in tables 1, 2, 3, 4, and 6*

Extent of injury	Families	Genera	Species	Extent of injury	Families	Genera	Species
	Number	*Number*	*Number*		*Number*	*Number*	*Number*
Severe	20	32	43	Light, occasional	44	82	109
Moderate	33	46	58	Immune	39	75	89
Light, general	37	58	67	Total			366

SUMMARY

The Japanese beetle, since it was first found in the United States in 1916, has spread outward in all directions at a rate of 5 to 10 miles a year until at the close of the 1938 season it had covered by natural spread an area of 15,100 square miles and had invaded parts of six of the Eastern States. Within this area are many suburban residential sections and tracts devoted to fruit growing and the raising of truck and field crops. The resulting diversification of plants has given the insect a wide choice of food, and it has been observed to feed to a greater or lesser degree on over 275 species.

In feeding, the beetle normally eats out small portions of the leaf surface and, as it avoids the veins, eaten leaves have a skeletonized appearance. These leaves turn brown and most of them fall from the plants. In the case of thin leaves with fine venation, irregular portions are cut out and eaten. This same type of feeding occurs on the petals of flowers. Small portions are eaten from the upper leaf surface of thick-leaved plants.

The beetle is a gregarious insect. Beetles often collect in large masses called "balls" and feed extensively on such preferred fruits as apples and peaches until only the core or stone remains. Balling sometimes occurs also on the foliage and flowers of food plants.

Japanese beetles feed most intensively on the foliage on the upper and outer branches of their food plants between 9 a. m. and 3 p. m. on bright sunny days. Feeding by this insect is light when the temperature is below 70° F., heaviest between 85° and 95°, and light above 95°. When the relative humidity is below 50 to 60 percent, beetles fly actively, but feed very little. When the relative humidity is above 60 percent there generally is little flight but feeding is heavy.

In general, the degree of feeding on any plant species depends on its attractiveness to the insect and the abundance of beetles in the vicinity. Though the succulency of the foliage of a plant and the odors given off by the fruit and leaves may govern the preference of the beetle for certain plants to some extent, the one known factor that makes many plants attractive is a high content of reducing sugar in the part which is usually attacked.

Feeding by the beetle in the heavily infested area first becomes conspicuous during the last week of June or early in July. After remaining for a time on such low-growing plants as smartweed, sassafras, and grape, there is a movement to the taller trees that are favored as food. Toward the end of the season, beetles leave the trees and are most abundant on roses, weeds, and plants that are continually putting out new tender leaves.

Certain plants are reported to kill the Japanese beetles when these feed on them. Some of the plants that have some toxic power are geranium, castor-bean plant, and the bottlebrush buckeye.

The injury caused by the beetle on various plants is, in this circular, classified in four main groups as follows: (1) Severe injury, (2) moderate injury, (3) general light injury, and (4) occasional light injury. Each of the plants on which the insect has been observed to feed is placed in one of these four categories. The various plants in the groups are arranged alphabetically by families and genera. A key number and an index giving the common and scientific names make it possible to find the classification of any plant listed. The tables show 277 plants on which the insect has been known to feed, as well as a list of 89 common plants on which feeding has never been observed.

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